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POINT-NONPOINT TRADING – CAN IT WORK?[1]

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ABSTRACT: Water quality trading between point and nonpoint sources is of great interest as an alternative to strict command and control regulations on point sources for achieving water quality goals. The expectation is that trading will reduce the costs of water quality protection, and may speed compliance. The United States Environmental Protection Agency has issued guidance to the States on developing point-nonpoint trading programs, and United States Department of Agriculture is encouraging farmer participation. However, existing point-nonpoint trading programs have resulted in very few trades. Supply side and demand side impediments seem to be preventing trades from occurring in most trading programs. These include uncertainty over the number of discharge allowances different management practices can produce, high transactions costs of identifying trading partners, baseline requirements that eliminate low-cost credits, the reluctance of point sources to trade with unfamiliar agents, and the perception of some farmers that entering contracts with regulated point sources leads to greater scrutiny and potential future regulation. Many of these problems can be addressed through research and program design.

(KEY TERMS: water quality trading; nonpoint sources; point sources; Clean Water Act.)

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Agriculture has significant impacts on water quality. Runoff and leaching of pollutants from agricultural chemicals and manure, and the runoff of sediment have contributed to widespread water quality impairments. Farmers and ranchers, for the most part, have little incentive to improve water quality. The primary United States (U.S.) water quality law, the Clean Water Act (CWA), only regulates pollution from point sources (factories, sewage treatment plants, some large confined animal feeding operations). Voluntary approaches for controlling pollution from agriculture are the mainstay of federal and state water quality improvement efforts. But benefits from water quality improvements occur mostly off the farm, and as these benefits generally have the characteristics of public goods, few producers are willing to voluntarily incur the costs of adopting management practices that improve water quality.

Water quality trading is currently of much interest as a market-based approach for improving the efficiency of water pollution control allocations among and between point and nonpoint sources in the U.S. Under the CWA, point sources (e.g., factories, sewage treatment plants) are regulated through a nontradable permit system. A permit specifies how much of a particular pollutant the permit holder can discharge. Traditionally, permittees were required to meet their permit obligations through their own

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effluent reductions. The United States Environmental Protection Agency (USEPA) policy guidelines on water quality trading now allow points sources to meet their Water Quality Based Effluent Limitation requirements through discharge reductions from other sources under certain conditions (USEPA, 2004). Under the USEPA policy guidelines, these sources may be regulated point sources or unregulated nonpoint sources. The guidelines encourage states to consider agriculture as a source of offsets in water quality trading programs, and a number of states are either implementing or considering water quality trading programs that allow point-nonpoint source trading.

The United States Department of Agriculture (USDA) is also very interested in water quality trading. In 2006, the Department announced a new policy on market-based environmental stewardship with the goal of broadening the use of market-based mechanisms for providing environmental and ecosystem services, such as credit trading (USDA, 2006). Such markets could provide a source of income to farmers and reward them for engaging in conservation activities. Farms can create offsets or credits for the market by implementing management practices such as conservation tillage, nutrient management, and buffer strips. As the price is determined in the marketplace, payments are not based on the costs of the practice, as in most traditional conservation programs. Farmers can also receive a payment for a much longer period of time than the two to five years of a standard conservation program contract.

There appears to be ample opportunity for point-nonpoint trading programs to be established. Almost 7,000 waters impaired by nutrients (pollutants produced by both point and nonpoint sources) have been listed under Section 303(d) of the Clean Water Act (USEPA, 2009). To date, over 4,000 total maximum daily loads (TMDLs) have been developed to address 5,000 of these impaired waters. As discussed below, the presence of a TMDL is a basic requirement for a trading program.

However, point-nonpoint trading has not been very successful to date, in terms of the number of point-nonpoint trading programs and number of trades (Breetz *et al.*, 2004; USEPA, 2008). Only 15 trading programs have been developed since 1980 that allow point-nonpoint trading for nutrients, and very few trades have occurred in these programs (Table 1). Much has been written about various issues related to point-nonpoint trading that may hinder market development and function, including uncertainty, trading ratios, transactions costs, and validation issues (Hoag and Hughes-Popp, 1997; Woodward and Kaiser, 2002; King and Kuch, 2003; Kieser and Fang, 2005; King, 2005; Ribaudo and Nickerson, 2009).

TABLE 1. Water Quality Trading Programs That Include Agriculture as a Source of Credits, Pollutant Traded, Baseline, Market Structure, and Number of Point-Nonpoint Trades as of 2008.

Project	Pollutant Traded	Number of Trades
Cherry Creek, Colorado	Phosphorus	0
Lower Boise River, Idaho	Phosphorus	0
Piasa Creek, Illinois	Sediment	1
Acton, Massachusetts	Phosphorus	0
Massachusetts Estuaries Project	Nitrogen	0
Kalamazoo River, Michigan	Phosphorus	0
Rahr Malting, Minnesota	Phosphorus	4
Southern Minnesota Beet Sugar, Minnesota	Phosphorus	400
Tar-Pamlico, North Carolina	Nitrogen, phosphorus	0
Clermont County, Ohio	Nitrogen, phosphorus	0
Great Miami River, Ohio	Nitrogen, phosphorus	0
Conestoga River, Pennsylvania	Nitrogen, phosphorus	0
Fox-Wolf Basin, Wisconsin	Phosphorus	0
Red Cedar River, Wisconsin	Phosphorus	22
Chesapeake Bay Watershed	Nitrogen, phosphorus	0

These issues can prevent trades from occurring, or increase the risk that trades will not be able to meet the water quality goals of the program. This paper discusses demand-based and supply-based issues facing point-nonpoint trading markets, and identifies steps that government can take to increase the changes necessary for point-nonpoint markets to succeed.

TRADING BASICS

Water quality trading is one type of what is collectively known as emissions trading. Emissions trading is organized around the creation of discharge allowances, which is a time-limited permission to discharge a fixed quantity of pollutant into the environment. Whereas water quality has the characteristics of a public good, making it difficult to control using market-based instruments, a discharge allowance has characteristics of a private good; it is rival and exclusive. Property rights are enforced by the regulatory agency managing the program.

A discharger (assumed to be a profit maximizing firm) must own allowances to legally release pollutants. A regulatory agency creates demand for discharge allowances by restricting the number of allowances in a market. The regulatory agency first determines the maximum amount of discharge of a particular pollutant a watershed can absorb and still meet environmental quality goals. This becomes the emissions cap for the watershed. The cap is used to set discharge limits for each firm that becomes part of the discharge permit. Discharge allowances equal to the emissions cap are allocated to all regulated dischargers through an auction or simply allocated free of charge according to some allocation rule (Tietenberg, 2006). By allowing the allowances to be traded, a market is created that allocates discharge among regulated firms.

If a firm discharges more pollution than its holding of allowances during the year, it would be subject to fines and penalties. If a firm does not have enough discharge allowances, it can either reduce discharges or purchase allowances from other firms. If a firm discharges less than its holding of allowances, it can sell the excess. A firm will purchase allowances in the market if the price is less than its cost of reducing a unit of discharge. If a firm can reduce discharges at a cost lower than the price of an allowance, it will reduce emissions below its permit requirements and sell the excess allowances and earn a profit. If the market operates smoothly, it can achieve environmental goals at a lower cost than command and control regulations alone (Tietenberg, 2006). Firms with low pollution control costs will provide proportionately more pollution control, reducing total pollution control costs. A market allows maximum flexibility for firms, in that a firm can meet its obligations by installing pollution control technology, adopting more efficient production technology, rearranging production processes, or purchasing credits (Ribaudo *et al.*, 1999). Emission trading has been very successful in reducing the costs of meeting sulfur dioxide emissions to the atmosphere from power plants. This program is estimated to have exceeded environmental goals at a savings of over US $1 billion, compared to a regulatory approach that does not allow trading (Stavins, 2005).

In the textbook example of emissions trading, all dischargers are regulated under the cap. In water quality trading programs, only point sources are regulated, but the USEPA allows regulated point sources to purchase credits from unregulated nonpoint sources such as agriculture. Sources of credits outside the cap are known as offsets.

Water quality trading markets must meet some basic conditions in order for demand for credits from nonpoint sources to develop (Bartfeld, 1993; Boyd and Banzhaf, 2006). Units of trade must be clearly defined, defensible ecologically and economically, consistently measured, and enforced by the regulatory agency. The commodity to be traded must be a single pollutant in a common form that is understood by market participants. There must be environmental equivalence between the discharge point of purchase and sale to ensure that expected water quality gains are achieved. The time frames for buyers and sellers of credits must be aligned, in that purchased reductions in discharge must be produced during the same time period that a buyer is required to produce them. The supply of nonpoint credits must be in balance with the point sources' demand for credits, in that there are enough potential nonpoint credits to satisfy the needs of potential purchasers. Otherwise, trading with nonpoint sources would not be able to generate pollution control savings.

The characteristics of nonpoint source pollution pose some problems for resource managers. Nonpoint source pollution from agriculture does not emanate from a single point, but leaves each field in so many places that accurate monitoring would be prohibitively expensive (Braden and Segerson, 1993; Shortle and Abler, 1997). The amount and quality of runoff leaving a field depend not only on factors that can be measured, such as the technology used and the use of variable inputs, but also on factors such as rainfall that vary daily and are difficult to predict (Braden and Segerson, 1993; Shortle and Abler, 1997). These characteristics have a bearing on the design of a point-nonpoint trading program.

Each water quality trading program must consider a number of design features that are critical to market function:

- Source of demand – the strength or stringency of the discharge "cap" on regulated sources
- Baseline – level of management or performance against which changes create credits for sale in a market
- Nonpoint source reduction calculations – method for estimating credits created by farmers
- Trading ratios – ratio applied to estimated nonpoint source pollution reduction to determine saleable credits. Used to account for reduction estimate uncertainty and location in watershed
- Market structure – define how trading will occur and infrastructure for reducing transactions costs
- Liability – who is responsible if promised nonpoint source reductions are not delivered.

Choices of these design elements play a large part in the success of trading in reducing compliance costs.

Experience with water quality trading programs highlights the problems with nonpoint source-created credits and some of the steps that can be taken to address those issues. To date, farmers have implemented management practices to produce credits for sale in only five [Rahr Malting (Minnesota); Red Cedar River (Wisconsin); Southern Minnesota Beet Sugar (Minnesota); Piasa Creek (Illinois); Great

Miami River (Ohio)], and trades between point and nonpoint have actually occurred in four (all but Greater Miami). Where trades have occurred, evidence suggests that cost savings over conventional regulations have been achieved. In the Rahr Malting case, bilateral negotiations with four farms resulted in two projects to convert farmland back to floodplain by restoring vegetation and setting aside the land through easements and two projects to stabilize eroding stream banks with structural work, one of which included livestock exclusion. Trading allowed Rahr to meet its discharge permit at a cost of about US$2.10 per pound of phosphorus reduced (Breetz *et al.*, 2004). It would have had to pay an estimated US$4-18 per pound of phosphorus reduced if it had installed pollution control equipment instead.

In the Red Cedar River nutrient trading program the City of Cumberland was able to meet its phosphorus reduction goal in 2001 for a cost of approximately US$20,000 through bilateral negotiations with farmers. It would have cost about US$35,000 to do so without trading. Phosphorus reductions were achieved for between US$1.23 and US$2.14 per pound.

ISSUES IN DEMAND FOR AND SUPPLY OF CREDITS FROM AGRICULTURE

The relative newness of the trading programs and the lack of overall trading activity to date make it difficult to identify which market features are important for success. However, initial experience and economic theory can provide some guidance on impediments to market function that might be overcome through market design or other actions by market managers.

Stringency of the Cap

The source of demand for credits in any trading program is a regulation that establishes a cap on discharges that is below current discharge levels. In the case of water quality, the TMDL provision of the CWA is the legal mechanism that establishes a cap on pollution discharges in impaired watersheds. Without a binding cap, there is no reason for regulated sources to seek credits in a market, as they can meet permit requirements more cheaply themselves, without having to seek trades. Nonbinding caps on regulated dischargers are cited as the reason for the lack of demand for nonpoint source credits in a number of trading programs (Breetz *et al.*, 2004; USEPA, 2008). Trading is an inappropriate tool when the cap does not create the demand for offsets.

One problem is that most discharge limits are based on design rather than actual flows (Selman *et al.*, 2009). This implies that if plants are not operating at their maximum capacity, they may not have to purchase offsets to meet their permits. In the Tar-Pamlico trading program, point sources were able to meet their discharge limits at very low costs without trades, because the cap turned out not to be binding. However, caps may become more binding over time as future growth increases potential discharge, and allowances remain fixed.

The pace of TMDL development has also caused problems for some programs. A number of programs, such as Lower Boise and Great Miami River, were developed in anticipation of TMDLs that have yet to be completed and put in place (Selman *et al.*, 2009). Without the TMDL, there is no demand for offsets. In the case of the Great Miami River, farmers were paid to reduce nutrient runoff out of a fund created with initial payments from point sources and government grants. However, point sources would not purchase offsets until the TMDL was established and their individual waste load allocations known (Selman *et al.*, 2009).

Practice Uncertainty

One of the requirements of trading is the equivalency of credits; ideally, the discharge reductions a point source purchases in a market have the same impact on water quality as if the firm reduced discharge itself. This assures that water quality goals are actually met. Establishing equivalency between point and nonpoint sources must account for two factors – agricultural practice effectiveness and location relative to the point source.

The effectiveness of a best management practice (BMP) for producing credits depends on site-specific conditions, its implementation, and how well it is maintained (Mid-Atlantic Regional Water Program, 2006). BMPs could include such things as a nutrient management plan, vegetative filter strips, conservation tillage, and drainage control. Uncertainty about such performance is a major stumbling block with point-nonpoint trading. Under the CWA a regulated point source purchasing offsets from an unregulated nonpoint source cannot transfer legal liability (Selman *et al.*, 2009). If a regulated point source is legally responsible for achieving a particular discharge goal, the uncertainty about credits generated by nonpoint sources and the risk of an enforcement action may make them an unattractive option. A point source's control strategy is generally a long-term decision, and it may be unwilling to rely on an uncertain source of credits because of the decision's inherent irreversibility (McCann, 1996). These factors may push point sources toward providing their own internal emission controls or trading with other point sources, rather than relying on nonpoint credits. Measurement problems were cited as obstacles in several existing trading programs (Breetz *et al.*, 2004).

One way that trading programs address this uncertainty is through an uncertainty ratio. An uncertainty ratio is a type of trading ratio, which generally requires more than one unit of nonpoint source discharge reduction to offset one unit point source discharge. Uncertainty ratios in water quality trading programs generally range from 2:1 to 5:1 (CTIC, 2006). This means that a point source would have to purchase up to 5 units of pollutant reduction from a nonpoint source in order to assure that its single unit of discharge is "covered." While providing insurance that the nonpoint source reduction provides the expected gain in water quality, a trading ratio increases the effective price of nonpoint credits, thereby reducing point sources' demand for them.

Uncertainty about practice performance also affects the potential supply of credits from farmers. Questions about practice performance leads to farmer uncertainty about the number of offsets they can reasonably expect to produce. This makes it difficult for a producer to determine whether it is financially beneficial to enter a market. Farmers uncertain about the potential economic benefits would be reluctant to enter a trading market.

Reducing uncertainty about practice performance would do three things. It would reduce some of the liability concerns, reduce the uncertainty ratio, and reduce farmer uncertainty about expected economic benefits from trading. One approach for reducing uncertainty is for the public sector to conduct research into the performance of practices under different conditions and to provide this information to trading programs and to farmers. The USDA's Agricultural Research Service conducts extensive research into the environmental performance of production practices, and could provide information that reduces uncertainty in trading programs. The Conservation Effects Assessment Project (CEAP) is a USDA effort to quantify the environmental benefits of conservation practices. Field-level sampling, monitoring, and modeling are being used to estimate the impacts of conservation practices on water quality.

Another approach is to develop simulation tools that are easy to implement, based on sound science, and accepted by both the regulating agency and farmers. Some water quality trading programs use simulation models to predict the performance of practices. CEAP includes watershed assessment studies that are to provide a framework for evaluating and improving the performance of water quality assessment models. Such models are critical for estimating the equivalency of water quality credits that are produced in different parts of a watershed. Models that can predict the movement of chemicals carried in runoff with a degree of certainty sufficient to allow agricultural credits to be traded would make it easier for producers to participate in trading programs. Models would also allow uncertainty ratios to be lowered, reducing the cost of agricultural credits and making them more attractive to point sources.

One modeling tool currently under development is the NRCS/USEPA Nitrogen Trading Tool (NTT). NRCS developed the NTT, in cooperation with the Agricultural Research Service and USEPA, as an online tool to help farmers determine how many potential nitrogen credits they can generate on their farms and sell in a water quality trading program (Gross *et al.*, 2008). It is based on a widely accepted model platform, and allows a farmer to enter geographic, agronomic, and land use information to estimate baseline nitrogen loadings, and changes in management practices or land use to calculate nitrogen load reductions that are the basis for credits in a trading market.

Another example of this type of information source is the World Resources Institute's NutrientNet (WRI, 2007). This is an online tool that can function as an information source for farmers. Configured to a specific watershed, NutrientNet allows registered users to evaluate different trading options and assesses the combination of practices that works best for a farm with a particular set of resource characteristics.

A second approach for reducing uncertainty's impacts on a market is to address the liability issue directly. A number of trading programs have created a reserve pool from excess credits that are produced through trading ratios that can be used by regulated point sources when an offset project fails to produce the expected number of credits (Breetz *et al.*, 2004; Selman *et al.*, 2009). This could increase the willingness of point sources to trade with nonpoint sources. Another approach is to encourage aggregators to operate with a market (Selman *et al.*, 2009). Aggregators act as middlemen between regulated and unregulated sources, purchasing credits from sellers and re-selling them to interested buyers. With aggregators in the market, the direct liability link between regulated sources and unregulated nonpoint sources is broken. The aggregator assumes the risk of nonpoint source performance. It can mitigate risk by holding a portion of the credits it purchases in reserve should a nonpoint source project fail to produce as many credits as expected.

Location

Establishing equivalency between nonpoint offsets and point source discharges also must take into account the location of nonpoint sources relative to the point source and the body of water being protected. As equivalency is measured at the point source, the fate of pollutants when they leave a field must be considered as they move downstream. Take two fields, one close to the point source and the other much further upstream. Identical reductions in nitrogen runoff at the two fields would have different impacts on water quality, as measured at the point source, due to biophysical activity along the way; the closer the source, the greater the impact. This difference must be accounted for when potential trades are constructed. A delivery or location ratio is another type of trading ratio, accounting for the location in the watershed of the nonpoint source relative to the point source; the smaller the distance, the smaller the ratio. While providing insurance that the nonpoint source reduction provides the expected gain in water quality, a delivery ratio again increases the effective price of nonpoint credits from farms located furthest from the point source, thereby reducing point sources' demand for them. There is not much government can do to reduce this effect, other than to develop good watershed models that keep such trading ratios to a minimum by reducing uncertainty related to delivery, or choosing watersheds for trading where this effect is not pronounced.

Cost of Finding Trading Partners

A potentially major issue facing point sources' demand for nonpoint credits is the cost of finding trading partners. Because farms are generally widely distributed across a watershed and each may be capable of producing a relatively small number of discharge credits, the transaction costs for point sources of identifying enough willing trading partners to satisfy their permits may discourage them from seeking trades with farms. Some markets have developed formal clearinghouses that assemble information from both buyers and sellers, making it easier for potential trading partners to find each other (Woodward and Kaiser, 2002; Breetz *et al.*, 2004). Third-party aggregators also play a role in a number of programs to assemble credits from nonpoint sources and market the credits to potential purchasers. Another benefit of third-party aggregators is that they can help address the issue of liability for regulated sources. Because an aggregator deals with a large portfolio of credits, it can more easily mitigate risks associated with delivery and performance of nonpoint source credits (Selman *et al.*, 2009). Both government and nongovernment organizations are playing roles of clearinghouse and aggregator.

Farmers may also face high transactions costs when trying to find trading partners. A farmer has to consider the type, amount, and timing of pollutant reductions generated on the farm and determine if they match the type, amount, and timing of pollutant reductions needed by regulated dischargers (CTIC, 2006). Unfamiliarity with the regulated community and the negotiation process could discourage producers from participating in a trading program. Third-party aggregators can also play a role in addressing this issue, especially if they have had close ties with the agricultural community. Land trusts and state conservation agencies are playing the role of aggregator in several trading programs. Trading programs have also established outreach programs to educate farmers about the opportunities trading might offer, and how to participate.

Fear of Regulation

Farm runoff is not regulated under the CWA, so producers are not compelled to actively seek trading partners. The expected returns from trading may not adequately compensate for the type of inspection and scrutiny the farm may receive if it enters into a trading program. Evidence from existing programs suggests that producers may also avoid trading programs because of a fear that entering into a trade is an admission that their farms pollute, exposing them to citizen complaint or future regulation (King and Kuch, 2003; Breetz *et al.*, 2004; King, 2005).

Limiting Flexibility

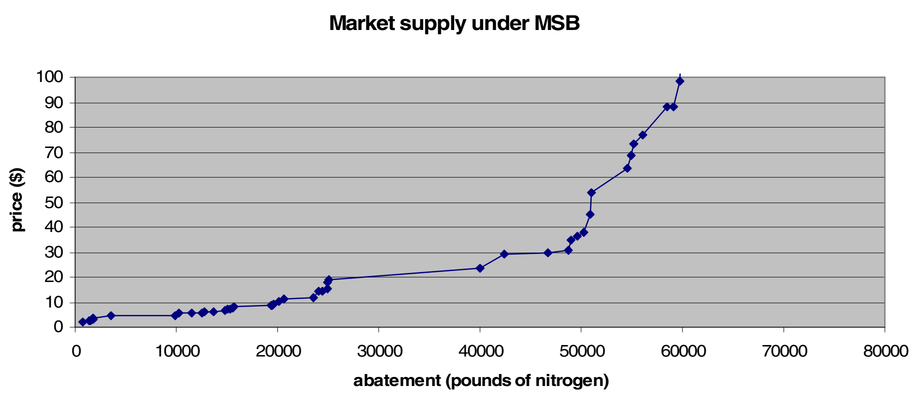
Some point-nonpoint trading programs specify a set of practices eligible for producing offsets, based on the availability of data on practice performance (CTIC, 2006). For example, in the Rahr Malting program, the state of Minnesota stipulated that credits could only be generated through soil erosion BMPs (other than reduced tillage), livestock exclusion, rotational grazing, wetland restoration, and land set-asides (Breetz *et al.*, 2004). While simplifying the programs' problem of evaluating potential trades, it limits the choices a farmer may make in supplying credits. One of the benefits of a market-based policy instrument like trading is that farmers are able to use their private knowledge about their operations to produce offsets at the lowest possible cost. While limiting farmer choices of how to produce offsets may reduce the managing agency's costs, it also reduces economic efficiency.

Baseline Requirements

The USEPA defines a baseline participation requirement (BPR) as the pollutant control requirements that apply to a seller in the absence of trading (USEPA, 2007). A seller must meet its baseline requirements to be eligible to generate credits. The selection of the baseline has major implications for the cost of nonpoint source credits, and ultimately the amount of revenue flowing to nonpoint sources for pollution control. Two basic approaches have been adopted by current water quality trading programs. The most simple is to set the baseline at whatever management practices were being used at a specific date. Any changes in management practices made after that date would generate credits (subject to other conditions, such as specifying practices for which credits can be calculated).

The second approach is to establish a baseline based on a level of stewardship, usually defined as generally accepted management practices or management practices implied by a TMDL (USEPA, 2007). For farms not meeting the baseline requirements, credits cannot be created until the base level of practice implementation is attained. The potential for a baseline to require something other than current practices presents an interesting dilemma for program managers. Under the CWA, there are no requirements for nonpoint sources to adopt BMPs, even in the presence of a TMDL. By requiring a minimum practice standard as the BPR to participate in the market, the regulatory agency may be disqualifying the "lowest hanging fruit"; the least costly reductions cannot be offered as offsets. It is possible that the incentives present in a credit market will be insufficient to induce farms that have not already voluntarily adopted the minimum set of practices to incur the cost of meeting the BPR; these producers are not compelled to adopt management practices and would continue to discharge. This entry cost would therefore potentially limit participation and adversely affect the efficiency of the market.

Figure 1 presents results for an analysis of the impact of Pennsylvania's trading rules for nitrogen in



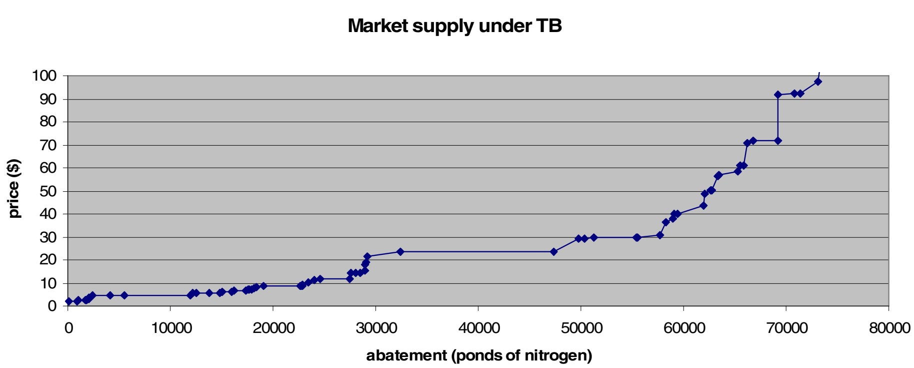


FIGURE 1. Market Supply Curves Under Minimum Stewardship Baseline (MSB) and Timed Baseline (TB).

the Conestoga Watershed. Pennsylvania trading rules require that riparian buffers be in place before credits can be produced (PADEP, 2008). About a quarter of farms in the watershed were assumed to be without riparian buffers. Estimates of credits produced at different market prices were derived from a model of dairy farms in the watershed. The market supply curves under the minimum stewardship baseline (MSB) and a baseline based on a starting date (what we call the timed baseline, or TB) are shown in Figure 1. As expected, the supply curve under the TB is shifted to the right, indicating more credits are available for a given price. Whatever the demand from point sources, the equilibrium price will be lower under the TB. While the water quality goal is met under both approaches (assuming away the other issues discussed above), nonpoint sources take on a greater share of the discharge reduction, and overall control costs are lower, under the TB.

An obvious recommendation is that the time-based baseline, rather than a stewardship-based baseline, be encouraged, as long as there are no regulations in place for nonpoint sources. Such a baseline provides an incentive for those acres most in need of treatment to be placed under some type of improved management. If a stewardship baseline is used, coordination of conservation programs with trading programs can address the issues of baseline requirements. USDA conservation programs such as Environmental Quality Incentives Program (EQIP) could be targeted to those producers not meeting the minimum level of stewardship to participate in a trading program. If successful, the number of producers likely to participate in the trading program would increase, increasing the potential supply of credits. However, average costs of credits would still be higher than if a stewardship-based baseline had not been used.

Interactions with Conservation Programs

Federally funded conservation programs and water quality trading programs can interact in several ways (Ribaudo *et al.*, 2008). Conservation programs and water quality trading program in a sense “compete” for land, the natural capital that is used to produce environmental services such as water quality. If conservation programs have been active in a watershed and a large percentage of farmers have already taken the lowest-cost actions to reduce polluted runoff, farmers’ ability to produce further reductions may be limited.

Farmers are very familiar with USDA conservation programs. Farmers have been dealing with them for decades, and more than 15% of all farms have received some type of assistance. Given a choice between participating in a trading program and a conservation program, familiarity alone may cause farmers to favor the conservation program (USEPA, 2008).

Rules of individual trading programs may present conflicts with conservation programs. Most trading programs do not allow producers receiving financial assistance for water quality-protecting management practices through federal programs to sell the subsequent water quality improvements as offsets to point sources, even if farmers pay part of the cost of the practice out of their own pocket, or if the practices were implemented to address an issue other than water quality. Allowing farmers who enroll in conservation programs to also sell resulting offsets in trading programs would increase interest in market participation, and reduce the amount of payment a farmer would be willing to accept to enter the conservation program (Ribaudo *et al.*, 2008). However, there would have to be rules for calculating how many credits the farmer can actually sell on a market to ensure the additionality of the trade.

CONCLUSIONS

There is great interest at the USEPA and USDA at promoting point-nonpoint trading as a way of reducing the cost of meeting water quality goals, and increasing the environmental performance of farms. The large number of TMDLs in place for nutrients would seem to provide ample opportunity for states to develop trading programs. If a market can be established in a water-quality impaired watershed, regulated sources would be a source of conservation funds that are targeted to farmers able to provide needed water quality improvements at least cost. Such targeting is generally not possible under USDA’s EQIP or other USDA programs. With private sources paying for reductions in farm-generated water quality impairments, conservation programs would be able to focus limited budgets on other issues such as wildlife habitat, water management, and air quality. Farmers would also benefit by enjoying an additional stream of income.

However, the experience of point-nonpoint trading programs currently in existence has not raised hopes that trading will flourish widely or achieve great success in reducing costs. A number of impediments to market development and function have been identified, including lack of binding caps, the uncertainty of practice performance, the cost of bringing buyers and sellers together, and location in the watershed. The ultimate goal of trading is to improve and protect water quality, so to the extent that these issues increase the risk for meeting policy goals, trading may not be a viable tool.

There are measures that the government can take to reduce these impediments and reduce the risk that water goals will not be achieved. The acceleration of the development of TMDLs should increase the number of potential trading programs for pollutants such as nutrients and sediment. Research can lead to greater confidence in practice performance, and the development of models for calculating credits and economic impacts on farms. Market structure features such as clearinghouses, or the use of third-party aggregators, can reduce transaction costs.

Some issues are more difficult to address. Point-nonpoint markets are generally thin, with relatively little potential for the type of active trading that is seen in the acid rain market. The reason is largely physical in nature. Water quality trading is limited geographically to watersheds with impaired waters. This constrains market size, reducing the number of credits that can be traded and working against the creation of high-volume, active markets. Expanding the watershed covered by a program may appear to increase the number of potential participants in a market, but the reality is that the increased distances between sources that trade would necessitate an increase in trading ratios, making trading less attractive.

Another factor is that because agricultural pollution is not regulated, farmers are not compelled to enter the market. Trading would work best if nonpoint sources were also regulated. This would create the impetus for agriculture to actively seek ways to reduce pollution loadings, and spur nonpoint-nonpoint trading as well as point-nonpoint trading. Regulating nonpoint sources would also do away with the baseline issue. More robust markets would lead to a greater volume of trades and greater cost savings. However, regulations on nonpoint sources are not likely any time soon.

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